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Economic Feasibility of a Model Cod Farm on the Lower North Shore

Economic and Commercial Analysis
Report n° 27

Pêches et Océans Fisheries and Oceans

Canada

Economic Feasibility of a Model Cod Farm on the Lower North Shore

Charles Cantin, Economist
Julie Bourdages, Research Assistant
Economic Services Division

Economic Services and Information
Systems Branch
Department of Fisheries and Oceans
Quebec Region
Québec City, Quebec
G1K 7Y7

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PREFACE

Several factors seem to favour the ongrowing of cod using fish caught in the trap fishery. But, in economic terms, is this type of cod farming viable? The Economic Services Division will attempt to answer that question by means of this study.

The publication of this document would not have been possible without the co-operation of many individuals. These resource persons were an indispensable source of information. We would like to thank, in particular:

The members of the aquaculture section of the Maurice Lamontagne Institute;

André Doyer of Baie-des-Chaleurs Aquaculture Inc. in Carleton;

Gaston Berthiaume of the Department of Fisheries and Oceans Canada, Development Division (Quebec); and

Placide Fequet of Canadian Saltfish Corporation.

And finally, we also thank all those who in one way or another helped make this report possible.

ABSTRACT

The aim of this paper is to determine whether it is economically feasible to grow cod (**Gadus morhua**) on the Lower North Shore of Quebec. The cod is purchased live from trap fishermen and then kept in sea-cages and fed capelin for a period of approximately 4 to 5 months.

Two financial scenarios are described and evaluated. Neither of them is profitable enough to justify codfish farming on the Lower North Shore. There are two reasons for this. First, the feeding costs are too high, but the main problem is that the mark-up value does not cover the cost of the ongrowing process.

Even if better economic conditions were to prevail, the risk would remain very high. A number of unpredictable biological factors could affect the species, with resulting production losses. The business of cod farming remains a high-risk venture.

SOMMAIRE

Ce rapport cherche à déterminer la faisabilité économique d'un élevage type de morue (Gadus morhua) situé sur la Basse Côte-Nord. Le présent éleveur engraisse, à base de capelan, de la morue de trappe achetée auprès de pêcheurs locaux.

Parmi les deux simulations financières évaluées, aucune d'elles n'est assez rentable pour encourager l'élevage d'une nouvelle espèce aquatique, la morue. Cette non-rentabilité s'explique par deux principaux facteurs. Premièrement, les frais en matière d'alimentation sont beaucoup trop élevés. Mais, le coeur du problème réside en ce qui a trait à la faible valeur ajoutée que procure l'engraissement de morue.

En dépit des meilleures conditions économiques qui pourraient prévaloir, le risque de se lancer en production demeure élevé. Des facteurs imprévisibles pouvant inluencer certaines caractéristiques biologiques propres à l'espèce, peuvent toujours survenir. La rentabilité de l'entreprise s'en trouve alors minée.

INTRODUCTION

The ongrowing of cod (Gadus morhua) using fish caught in traps is attracting more and more public interest. The establishment of a Newfoundland company[1] that farms this species has a lot to do with this heightened interest. Several million dollars have been invested in the venture, which involves growing cod on a commercial scale. Just how seriously the venture is being taken can be seen from the fact that the company has reserved the exclusive right to carry out this type of fish farming in the province of Newfoundland.

Many factors attract those with an interest in cod farming. First, it would add value to cod, which is usually caught and sold in a very small size, and therefore at a low price. The availability of male capelin, a low-cost feed stock, is a second potential advantage. Another attractive factor is that the cod would be bought at a time of year (spring/summer) when the price is relatively low, and sold at a time (fall/winter) when it would supposedly fetch a higher price. Although, qualitatively speaking, these factors appear advantageous, a fundamental question remains. Could this type of activity be profitable on the Lower North Shore, where a supply of trap cod is readily accessible?

It is in this context that the Economic Services Division of Fisheries and Oceans (Quebec Region) decided to assess the financial viability of a model cod farming operation on the Lower North Shore.

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[1] Sea Forest Plantation Company Ltd

1. OVERVIEW OF CERTAIN BIOLOGICAL ASPECTS OF THE SPECIES

This section is not meant to be an exhaustive study of the biology of Gadus morhua. The choice of variables is based rather on their potential impact on cod farming. Moreover, since only fish weighing one kilogram or more are to be ongrown, only the juvenile and adult stages of the codfish will be discussed. The salient points connected with these variables are all the more relevant because they indicate the degree of risk and uncertainty associated with this type of operation.

Distribution area

Two major cod stocks are found in the Gulf of St Lawrence. The northern stock occupies divisions 4R and 4S and subdivision 3Pn, while the southern stock occupies division 4T and subdivision 4Vn. The figure in Appendix 1 shows the boundaries of these respective fishing areas.

Only the northern stock (4R-4S, 3Pn) will be discussed here, since it is these fish that are trapped by fishermen on the Lower North Shore.

Migration of stock in 4RS, 3Pn (see figure in Appendix 2)

According to certain biological data, it would appear that around November the stock in 4RS, 3Pn moves away from the northern Gulf and migrates farther south along the Newfoundland coast. It winters near the Cabot Strait.

During the spring migration period (March-April), the codfish in this stock leave the southeastern sector of the Gulf and the southwestern coast of Newfoundland and head for shallow waters on the west coast of Newfoundland (4R) and the coasts of

Quebec (4S). The spawning and feeding areas correspond to those regions (GRAIGE UQAM and GREPA LAVAL, preliminary report, 1989).

Although cod landings on the Lower North Shore were relatively stable in 1987 and 1988, they have declined considerably in the past four years, falling from 7004 metric tons in 1984 to a mere 2313 tons in 1987 (see Appendix 3). If cod catches continue to decline, would the cod farming business be threatened? Would the supply of trapped cod be sufficient to make the operation viable? Two questions that are worth asking...

Rose and Leggett (1988) have shown that wind direction and force as well as ambient air temperature may help to explain the presence of cod in the North Shore region at certain periods of the year. Furthermore, the results of a study conducted by the same authors show that the distribution of cod follows that of capelin, provided the temperature favours such behaviour. Changing environmental conditions may therefore influence the supply of cod available to fish farmers.

Sexual maturity of stock in 4R-4S, 3Pn

Gonad maturation, a phenomenon that recurs yearly once codfish have reached adult size, is of considerable importance to a fish farming operation. Fish that are about to reach maturity, at least those in captivity, stop feeding for two months. Their growth also slows down, resulting in higher production costs for the fish farming business.

Between 1973 and 1976, Minet (1978) studied the average age at maturity of the codfish stock in the northern Gulf. His findings showed that males reached maturity at roughly 5.5 years and measured 45.7 centimetres (18 inches) on average at this stage. Females reached maturity a little later, at 6.6 years, at which time they measured 52 centimetres (20.5 inches). Since the hypothetical business is planning to grow cod beginning at 45 centimetres (18 inches), most of the fish risk reaching maturity during the farming process.

Growth rates

Cod is a relatively fast-growing species. Codfish raised in cages will have an average weight gain of 88.8%[2] between July and November, the ongrowing period. This percentage takes into account gonad maturation, which may delay the growth of fish during this period. Temperatures recorded on the Lower North Shore at that time of year vary between 5 and 12 degrees Celsius.

Maximum growth would be achieved at temperatures of between 13 and 15 degrees Celsius (Jobling 1983). However, one must consider that codfish continue to feed at temperatures as low as 0 of 1 degree (Saunders 1962, unpublished data). Cod is therefore a species that tolerates a wide range of environmental conditions (Scott and Scott, 1988). This characteristic is a significant advantage for fish farming.

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[2] This growth rate is based on the experience of a Newfoundland cod-farming business. The fish weighed an average of 1.07 kg at the time they were caged (July). Four months later (December), ready for market, they weighed 2.02 kg.

Feeding

The diet of juvenile cod consists primarily of fish and crustaceans. As they grow, codfish switch from capelin to herring. The conversion rates observed - between 2:1 and 3:1 - are excellent. Furthermore, codfish require a daily food intake.

Parasites

Growing cod in cages does not eliminate the risk that they may harbour parasites. The species does, after all, originate in the wild. The best-known cod parasite is a nematode commonly known as sealworm. It poses no threat to humans provided the fish are frozen or cooked at a minimum temperature for a minimum time. Capelin may also harbour these organisms. However, they would be frozen before being fed to the codfish, so that any parasites would be killed.

Mortality rates

There are few available data on mortality rates during test farming. One problem that remains to be solved is cannibalism. Hierarchies of dominance form among fish in the same cage, with the result that the weakest fish have a very low growth rate or none at all. They may be preyed upon by the more powerful fish in the cage.

The business in question will attempt to overcome this obstacle by regularly separating the codfish according to size.

Another problem is the stressful adjustment phase that the cod must go through when they are first transferred to cages.

Diseases

Thus far, only two diseases affecting codfish have been identified. The most damaging is vibriosis, a bacterial disease. The second disease reported is caused by a virus: viral erythrocytic necrosis. The virus causes anaemia and disrupts the metabolism of red blood corpuscles. It does not, however, cause death (Reno et al, 1986).

Cod is a species that, in response to stress, may also develop exophthalmia through gas accumulation in the eye. The resulting lesion is an entry point for opportunistic infection.

Predators

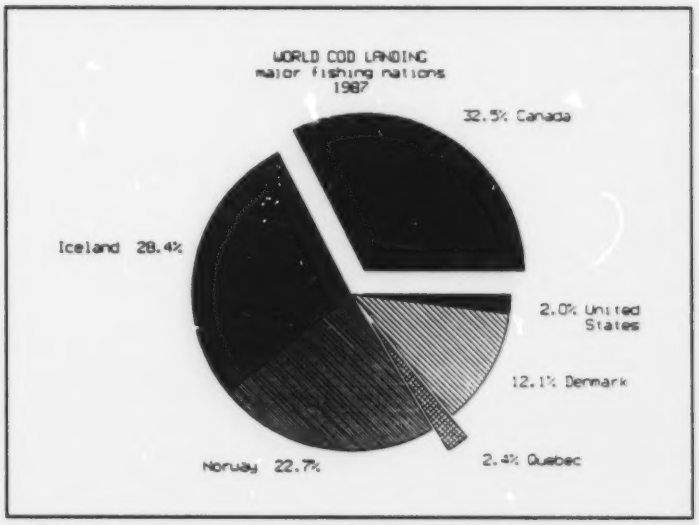
It appears that the principal cod predator in the Gulf is the grey seal. Its presence in large numbers also cuts into the stock of capelin, which may have a further impact on the cod population. Moreover, the seal is a codworm host. Increased worm infestation among codfish in the Gulf may be explained by the rise in the grey seal population over the same period (Malouf, 443:1986).

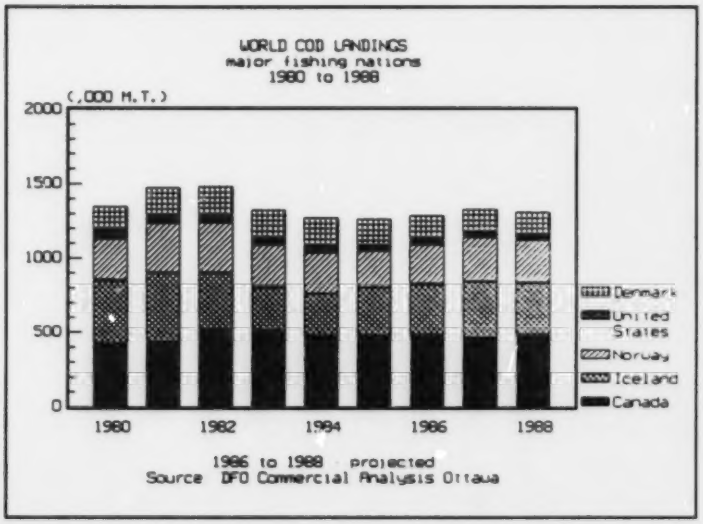
2. OVERVIEW OF CERTAIN ECONOMIC ASPECTS OF THE SPECIES

Like Canada as a whole, Quebec is a fish exporter, and is therefore subject to international market forces. Any fluctuation in world markets, whether in the supply of or demand for fish products, has a direct impact on Quebec fishing revenue. since aquaculture could to some extent complement fish production in Quebec, it would be subject to the same market forces.

World landings

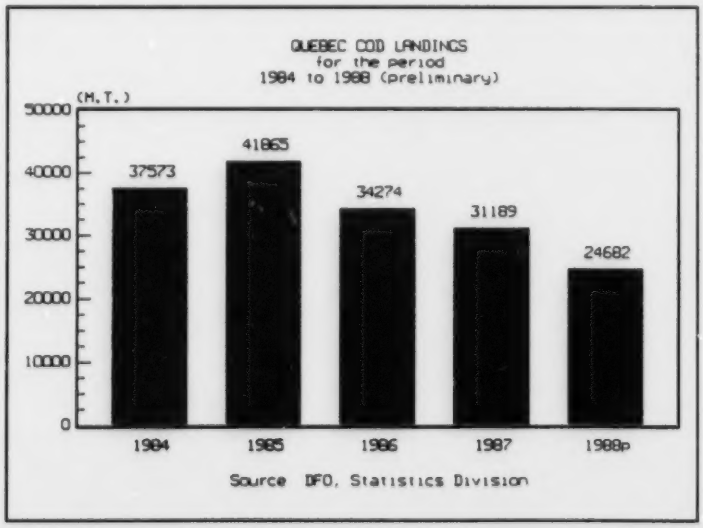
World landings of cod in recent years have averaged around 1.9 million metric tons. Five countries account for over 60% of total landings. In declining order, in 1987, they were Canada, Iceland, Norway, Denmark and the United States. Of the 1,325,000 metric tons landed by those countries in 1987, Quebec accounted for 2.4%.





Since 1983, cod catches landed by these countries have remained fairly stable. This indicates that the supply of cod has not been the determining factor in cod price fluctuations in recent years. The stability of landings regardless of market price and the history of this industry strongly suggest that world stocks are being fished to the limit. Although the FAO believes that catches could be increased through a more efficient management strategy it is unlikely that the supply of cod from traditional fisheries will increase sufficiently on a world scale.

Quebec landings

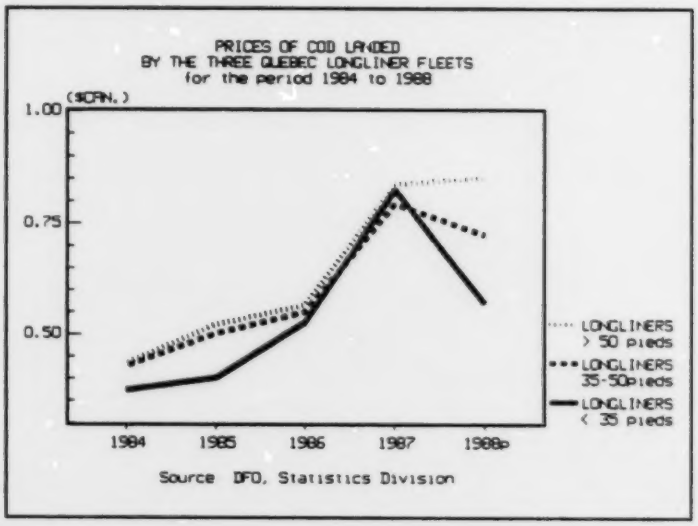


Cod landings in Quebec have been declining since 1985. Moreover, preliminary figures for the 1988 fishing season show that catches will drop even further in relation to 1987. Throughout the Gulf of St Lawrence, fixed-gear fishermen have suffered most from this dwindling supply. Fixed-gear boats, particularly longliners, catch a major share of the large fish used by the dry-salted cod industry. As a result, there is

likely to be an even greater shortage of large cod for this market. If the dry-salted cod market remain at its 1988 level of activity, the shortage of large cod would result in higher prices being paid to fishermen who catch such fish and to any fish farmers who grow them.

Prices paid in Quebec

In Quebec as in other regions of the Gulf, fishermen with fixed gear (longliners) catch the large cod. The biggest longliners (50' and over), because they can cover a larger area than smaller ones, are better able to fish for larger cod. Landed values in 1988 reflected differences in fish size in catches by longliners in the Gulf. Based on 1988 prices, a fish farmer could profit by growing large cod.



The price of Icelandic and Norwegian cod is significantly higher than that of Quebec cod. This price difference can be attributed to the fact that buyers consider the former to be of higher quality. Fish farming could be an alternative means of supplying higher-quality products and thus obtaining a price equal to, or even higher than, the price of Icelandic and Norwegian products.

The stability of world production, the decline in Quebec landings, the scarcity of large cod and an improvement in the quality of cod are all factors that may make cod farming attractive.

3. PRODUCTION CYCLE

The development of a cod farming industry can be approached in four different ways.

Concept 1: - A first possibility would be to raise cod from the egg stage and to sell it on the consumer market when full-grown.

Concept 2: - A fisherman could decide to hold his catches until a glut at processing plants caused by an oversupply of fish has eased. In this case, the fisherman would not do any ongrowing.

Concept 3: - The same fisherman could choose to branch out by feeding his cod catches, thus adding value through weight gain.

Concept 4: - Finally, a company specializing in ongrowing could buy trap cod from fishermen.

A combination of two or three of these scenarios could also an option open to fish farmers. The choice of production mode would naturally be influenced by prevailing economic conditions and by the availability of investment capital.

This study is aimed at determining the financial viability of concept 4 - the ongrowing of cod. Using trap cod as a supply is preferable because trapping makes it possible to catch cod without damaging the fish.

Trap fishing is carried out almost exclusively on the Lower North Shore, making this area the obvious choice as the site of the hypothetical fish farm. Since the cod supply comes from traps, the location of the cages depends on where the actual fishing is done. Other factors to consider in order to minimize transportation costs are the proximity of the owner's home and of freezer facilities in which to store fish to feed the caged stock.

On the Lower North Shore, trap cod is normally fished from June 15 to July 15. The cod farmer would therefore buy his supply from fishermen during that period. The codfish bought would measure between forty (40) and sixty (60) centimetres. They would be brought from the fishing ground to the farm in a submerged floating cage (see figure in Appendix 4). At the farm, the cod would be transferred to another type of cage and be fed male capelin exclusively. The choice of capelin as feed is based on its availability and the fact that it is usually discarded by fishermen. The short capelin fishing season makes it necessary to freeze the fish.

The ongrowing period will extend over four months. The farm's entire stock will be sold to processing plants at the end of that period, in November of the same year.

4. WORKING HYPOTHESES

The value of a study such as this is founded on production hypotheses. Although cod is not currently farmed commercially in Quebec, existing documentation on the subject does make it possible to define production parameters.

Despite the fact that the most plausible scenario would be to have fishermen farm cod themselves, fishing and farming activities have been separated in order to better determine the viability of ongrowing per se.

Hypothesis 1 The company produces cod using fish bought from fishermen. It is assumed that ongrowing facilities are situated no more than a few kilometres from the home port and the fishing grounds.

Hypothesis 2 Fifty-six (56) metric tons (mt) of cod are bought from fishermen. This quantity represents approximately 25% of the total catch of an efficient crew using, on average, three traps. Generally speaking, the cod is purchased between June 15 and July 15. The average weight of the fish at this stage is 1.07 kg (2.35 lbs) while their average unit price is $0.40/kg for whole cod ($0.18/lb) or $0.44/kg for head on gutted cod ($0.20/lb).

Hypothesis 3 One hundred (100) metric tons (mt) of cod are sold at the end of the ongrowing period, that is after 120 days of feeding. This production level is calculated according to an estimated mortality rate of 10%. At the final stage, the fish weigh an average of 2.02 kg (4.44 lbs). The sales price is approximately $0.44/kg ($0.20/lb) for whole cod or $0.48/kg ($0.22/lb) for head on gutted cod. The entire production should be sold between October 15 and November 15.

Hypothesis 4 The cod is fed male capelin at a ratio of 3 kilograms (kg) for every 1 kilogram (kg) of cod produced. Each cage is fed two rations of frozen food daily. The price of capelin averages $0.40/kg ($0.18/lb). It is assumed that the feed stock is stored in dockside facilities near the farming site.

Hypothesis 5 One employee is considered sufficient to handle the regular operations of the cod farm. When extra work is required, additional manpower is provided to meet the need.

Hypothesis 6 The codfish are fed for 110 days before feeding is stopped during the last ten days of the production cycle.

Hypothesis 7 The entire capital needed to set up the operation is invested during the first year.

Justification of certain hypotheses

The hypothetical nature of this project requires that certain elements be explained further.

- PRODUCTION LEVEL:

One hundred (100) metric tons of cod will be sold after four (4) months of ongrowing. This production level is based on a study conducted in Scotland[3] which closely resembles the project under discussion here.

- QUANTITY OF COD PURCHASED:

To achieve a production level of 100 metric tons, approximately 56 metric tons must be purchased. This quantity was determined based on an anticipated growth rate of 88.8%[4] and a mortality rate of 10%.

- PRICE:

(a) cod: The prices paid to fishermen by cod farmers for their supply of cod and the prices obtained by fish farmers when they sell the cod are the averages of prices currently in effect, at the time of writing, on the Lower North Shore.[5] One must

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[3] Source: A. Jones. Does cod farming have a commercial future? A technical and economic assessment. Foldevigen rapportser, 1, 1984, 0333-2594, The propagation of cod (Gadus morhua).

[4] Source: The growth rate is calculated on the basis of data contained in the study: "Assessments and Observations of a Cod Farming Operation in Newfoundland", Canadian Industry Report of Fisheries and Aquatic Sciences, No 14.

therefore take into consideration that prices may fluctuate over the course of the year.

(b) capelin: The price of frozen capelin is the current price on the US market. It includes freezing, handling and storage costs.

- MORTALITY RATE:

The unique nature of the ongrowing technique in this project makes it difficult to apply mortality rates documented in scientific literature. The losses incurred by a Newfoundland operation[6] that is relatively similar to the one described here were therefore used. This figure applies only to the last 14 weeks of the growing period. In percentage terms it corresponds to a mortality rate of roughly 2%.

There is another period, however, in which fish are particularly likely to die. The stress that codfish suffer during there first two weeks of living in cages (including the transfer stage) is far more intense than the stress during the last 14 weeks. It has therefore been determined arbitrarily that 8% of the cod purchased would not survive the transfer to cages and/or the early ongrowing period.

The sum of the two mortality rates justified above will cover all losses during the entire ongrowing period. The overall mortality rate that will be used is therefore 10%.

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[5] Taken from Canadian Salt Fish.

[6] Sea Forest Plantation Company Ltd.

- CHOICE OF DIET:

The choice of a capelin-based diet is supported by the plentiful supply of this species on the Lower North Shore. Thirty-eight (38) exploratory capelin fishing licences have recently been issued in the area.[7] Eventual cod farmers in the region would thus benefit from the availability of an unexploited local resource. Male capelin would serve as basic feed for the ongrowing of cod while female capelin would be sold on the Japanese consumer market for its roe.

- LENGTH OF PRODUCTION CYCLE:

The maximum ongrowing period would be between July 15 and November 15 so that all the cod would be sold before ice forms in the Gulf. The ice factor aside, research indicates that growth gains are virtually nil after the month of November.

- FOOD CONVERSION RATE:

According to Williams Kiceniuk (1986), the conversion rate of capelin to cod is approximately 3:1. This ratio roughly reflects the return on feed and means that three (3) kilograms of capelin are needed to grow one (1) kilogram of cod.

- NUMBER OF CAGES:

A pilot project carried out at the Maurice Lamontagne Institute shows that a volume of ten cubic metres (10 m^3) can

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[7] Statistics Division, DFO Quebec Region.

contain 750 codfish, each weighing three-quarters (3/4) of a kilogram. Fifty-two (52) kilograms of cod can thus be concentrated in every cubic metre (m^3). This experiment was conducted in a basin in which the oxygen content of the water was controlled. Since the cod in this project will be held in cages submerged in the open sea, it was decided that the results of the experiment remained valid. A cage measuring 600 m^3 will therefore be able to hold 31 metric tons. Since the target production level is 100 metric tons, three cages of this type would be sufficient.

5. BUSINESS STRUCTURE

The technical and economic data used to prepare this report were drawn from literature on the farming of cod. The experience of a great many resource persons interested in the subject was a further and invaluable source of information.

No sales tax has been applied to the purchases of the various equipment needed to operate the farm.

5.1 Investment

As already mentioned in the base hypotheses, the entire capital required to pay for equipment will be invested in the first year of operation, that is in 1989.

The cages in which the cod will be held account for the bulk of investment. As a result of the satisfaction expressed by certain companies[8], the Norwegian type of cage was chosen. The cages, all three made of durable polyethylene, have a life of 15 years. Circular in shape, each has a circumference of 40 metres. With an individual capacity of 600 cubic metres, each cage can hold 31 metric tons of cod. The pens extend one metre out of the water and are held there by a double flotation bar. Each cage

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[8] Baie-des-Chaleurs Aquaculture Inc. in Carleton.

includes a collar surrounded by a net to contain the cod, as well as two barrier nets, one to protect the cod from marine predators and the other to keep birds from feeding on the fish. The entire outlay required comes to approximately $7500[8] a cage. The net attached to the collar has a 45-millimetre mesh while the protective nets have a mesh corresponding to that used at the mouth of a trawl net. An additional $500 is set aside to cover the cost of replacing the main net.

Fixtures and cables totalling $470 per cage are needed to stabilize the structure. This small equipment is meant to be replaced after five (5) years of use.

The cost of constructing a "transport-cage" to bring fish to the farming site is estimated at $3000. A fairly similar model is shown in Appendix 5. However, to allow the cage to glide more easily through the water, the forward end should be triangular instead of rectangular. Its useful life is the same as that of the fixtures and cables.

A 21-foot boat with a 45-horsepower engine is another capital investment item. The craft will be used mainly to transport capelin from fish processing plants to the farming site. It will also be used the tow the transport-cage. The cost of purchasing the boat is estimated at $7200 and it is amortized at an annual rate of 20%.

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[9] Taken from the document entitled: Assessments and Observations of a Cod Farming Operation in Newfoundland, page 4.

A grinder costing an estimated $5000 will cut up the frozen capelin to be used as cod feed. It will be amortized over five (5) years.

Various tools will be required to maintain the operation. They will cost a total of $1000. Their expected life is identical to that of the nets, boat and grinder (5 years). The table below summarizes the investment needed to produce 100 metric tons of cod and the life of each investment item.

Table 1: Investment required for a farm producing one hundred metric tons of cod

ITEM	PRICE ($)	LIFE (YEARS)
Cages	22 500	15
Replacement net	500	5
Fixtures	1 410	5
Transport-cage	3 000	5
Boat	7 200	5
Grinder	5 000	5
Small tools	1 000	5
TOTAL INVESTMENT	40 610	

5.2 Operating costs and revenue

The start-up phase of the business under study is spread over only four (4) months, which means that the company will earn revenue in its first year of operation, 1989.

Operating costs and revenue have been split into two management accounts (ONGROWING and GENERAL).

Labour is expressed in person-hours. The hourly wage includes 12% in fringe benefits. The employee will be responsible for transferring the cod from traps to cages. He will also be in charge of bringing capelin to the ongrowing site and distributing it to the fish. Then, once the cod have reached the desired weight, the employee will transport the fish to processing plants. In addition to these regular duties, the employee will be expected to perform a number of other tasks (management, cage assembly...). The employee's pay has therefore been adjusted accordingly to cover all hours worked. This adjustment raises the average annual salary to $30,000. Over four months, the time needed to grow the cod, the employee's salary therefore comes to $10,000.

The amount allotted for the maintenance of cages represents 10% of their purchase value, or $2250.

A tank containing 23 litres of fuel is sufficient for the distance covered every day by the boat. Based on the length of the production cycle, the cost of fuel will be roughly $1750.

6. DESCRIPTION OF SIMULATIONS AND ANALYSIS OF RESULTS

The two financial scenarios for the cod farm were simulated using computer software developed by a research team at Laval University[10]. This tool, originally designed strictly for agricultural purposes, had to be adapted to the needs of this study.

It is essential to remember that the validity of the results that follow rests on the base hypotheses formulated above. The reader should therefore be careful before generalizing the application of these results.

The results presented in appendices 5 and 6 are divided into several sections designed to inform the reader. First, the opening balance sheet shows the investment needed to start up the company and the loans contracted to finance the purchase of equipment. Subsequent pages show balance sheet changes, the statement of operating income showing margins under the two nominal accounts (GENERAL and ONGROWING Appendix 5) and the cash account. As its name suggests, this last account shows the company's cash situation at the end of the year. For example, an entrepreneur may be forced to use his line of credit if his cash balance is negative, or suppliers might help him by advancing funds.

The opening balance sheet is adjusted according to the various changes within the operating account and the cash account. After these adjustments are made, the opening balance becomes the closing balance. The latter shows the "health" of owner's equity. Thus, the owner will profit if the balance is positive and lose money if the balance is negative.

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[10] Agri-gestion Laval Inc

Since the production cycle of a cod farming operation is four months, each simulation is spread over a full year.

The ultimate purpose of this study is to assess the economic viability of cod farming. Therefore, to make results easier to understand, the simulations have been reduced to their simplest terms. Only those factors deemed necessary to assess the profitability of this type of fish farming have been considered.

Results will be analysed according to two variables. This choice is based on the fact that the owner's cash situation and equity as described above are the key indicators allowing for a rapid diagnosis of the general state of the business.

6.1 Simulation without government support

The first simulation corresponds to the situation that might prevail on the Lower North Shore if such an operation existed. The sales price of cod reflects what a fish farmer in that region can expect to get for his product. Furthermore, the unit price of capelin comes from a reliable source of information. It has been assumed that the entrepreneur does not initially invest any of his own capital. Operating capital is financed with a short-term (1 year) loan at 14% interest while all capital investment is financed through medium-term (5 years) and long-term (over 10 years) loans at 12% interest. The total amount of investment is $40,610. This includes $22,500 for cages and $18,110 for other equipment such as the boat, the grinder, the transport-cage, etc (for details, see Table 1).

Results (see Appendix 6)

Cash: At the end of the year it stands at -$67,725. The fish farmer will therefore need to use a line of credit equivalent to this amount if he wants his business to survive. He is in a difficult position because more money is going out than is coming in.

Owner's equity: At the start of operations, it was agreed that the owner's equity was nil. The cod farm, far from turning a profit, has left him $71,482 poorer.

6.2 Simulation with government support

A second possibility is worth considering in view of the non-viability of the preceding simulation. A financial assistance program for the development of fish farming established by the Quebec Department of Agriculture, Fisheries and Food is currently in effect. The program tends to support projects aimed at diversifying aquaculture production intended for the table market. This diversification may be achieved by farming species that are currently commercially under-exploited in Quebec. Based on these eligibility criteria, a cod ongrowing operation would qualify for assistance under the program.

The second simulation, in addition to the same elements found in the first, includes a grant from the Quebec Department covering 60% of capital investment, equipment and operating costs needed to operate the farm. This grant amounts to $24,366. The balance (40%) comes from medium- and long-term loans.

Results (see Appendix 7)

Cash: It improves somewhat but remains negative. The government subsidy cuts loan repayment annuities by $541. This difference also appears in the cash balance, which now stands at -$62,184.

Employer's equity: Although the owner is now a little less poor (-$43,586), the company is really no more healthy than before. The grant from the provincial government ($24,366) explains the apparent improvement. The result is, in effect, artificially inflated.

It is interesting to look more closely at the results to try to determine the cause or causes of the project's non-viability, even when subsidized. For a start, the gross margin is -$54,664! It shows that the business, even before annual loan repayments, does not take in enough revenue from sales to cover expenses directly tied to the ongrowing of cod. Indeed, this activity brings in $44,000 and involves expenditures of $98,664. Sixty-three per cent (63%) of these total expenditures are devoted strictly to supplying the farm with capelin. Therefore, at what price would the owner need to be able to buy capelin to avoid recording a loss on his operation? Simple calculations show that even if capelin were supplied free to the company, it still would not turn a profit! One might also ask at what price the company should sell its cod in order to earn sufficient revenue to cover its operating expenses, including the purchase of capelin. The same type of calculation indicates that only at a price of $1.12 per kilogram of cod sold would the business break even! These are simply not in line with the current situation.

7. DISCUSSION

As our analysis of the results shows, two variables largely help to explain the non-viability of cod farming. To begin with, the cost of supplying his operation with capelin is more than the fish farmer can afford to pay. However, the main problem remains that the sales price of the cod is too low. It has already been mentioned that the company would just manage to break even if it could sell its cod at $1.12 a kilogram. But is it realistic for a fish farmer on the Lower North Shore to expect to receive such a high price for his product?

The test year used to determine profitability is 1988. The prices in force paid to cod fishermen in 1988 are a considerable advantage to the cod farmer. While a kilogram of trap cod would cost him an average of $0.57 per kilo [1]1, he would receive approximately $0.85 per kilo at the end of the ongrowing period [1]2.

Compared with the current year, in which the fish farmer would record a small gross profit of $0.04 per kilogram of cod sold, in 1988 the same fish would have earned him $0.28. Even with this high price differential, the ongrowing of cod would not be profitable. The negative cash balance (-$30,697) corresponding to the situation in 1988 supports this view. And prices paid to fishermen would have to rise again. Even if they did, would the seasonal price differential be as pronounced?

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[1]1 Price received by longliners under 35' in 1988.

[1]2 Price received by large longliners (> 50') in 1988.

CONCLUSION

The aim of this study was to assess the economic feasibility of ongrowing cod using trap cod on the Lower North Shore.

In light of the results obtained, even with a government subsidy, a company operating this type of fish farm cannot be profitable. There appear to be two main reasons for this. First, the cod feed must be bought at a price that the fish farmer cannot afford. Second, it costs the farmer too much to buy his supply of cod from fishermen given with the sales price he can expect for the final product. The operation will reach the break-even point only if it obtains, for example, one of the price combinations shown in the table below.

Table 2: Impact of feed costs on the sales price of cod at the break-even point

CAPELIN ($/kg)	COD ($/kg)
0.40 ($0.18/lb)	1.12 ($0.50/lb)
0.26 ($0.12/lb)	0.90 ($0.41/lb)
0.13 ($0.06/lb)	0.70 ($0.32/lb)
0 ($0.00/lb)	0.50 ($0.23/lb)

Thus, in a situation where the average sales price of cod is $1.12/kilogram, the farmer would not lose money if he bought capelin at $0.40/kilogram. These price combinations are valid if the trap cod is bought for around $0.40 a kilogram from fishermen.

Even under the best economic conditions, certain biological risks associated with the species may impair the viability of cod farming. Moreover, the current absence of such activity means that applying certain working hypotheses remains risky. Only when a cod farm goes into operation will be the results become clearer.

The availability of trap cod on the Lower North Shore also remains questionable. Would stocks be sufficient to provide an eventual cod farmer with a regular supply of cod even if the project were economically feasible?

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APPENDICES

APPENDIX 1

NORTHWEST ATLANTIC FISHING AREAS

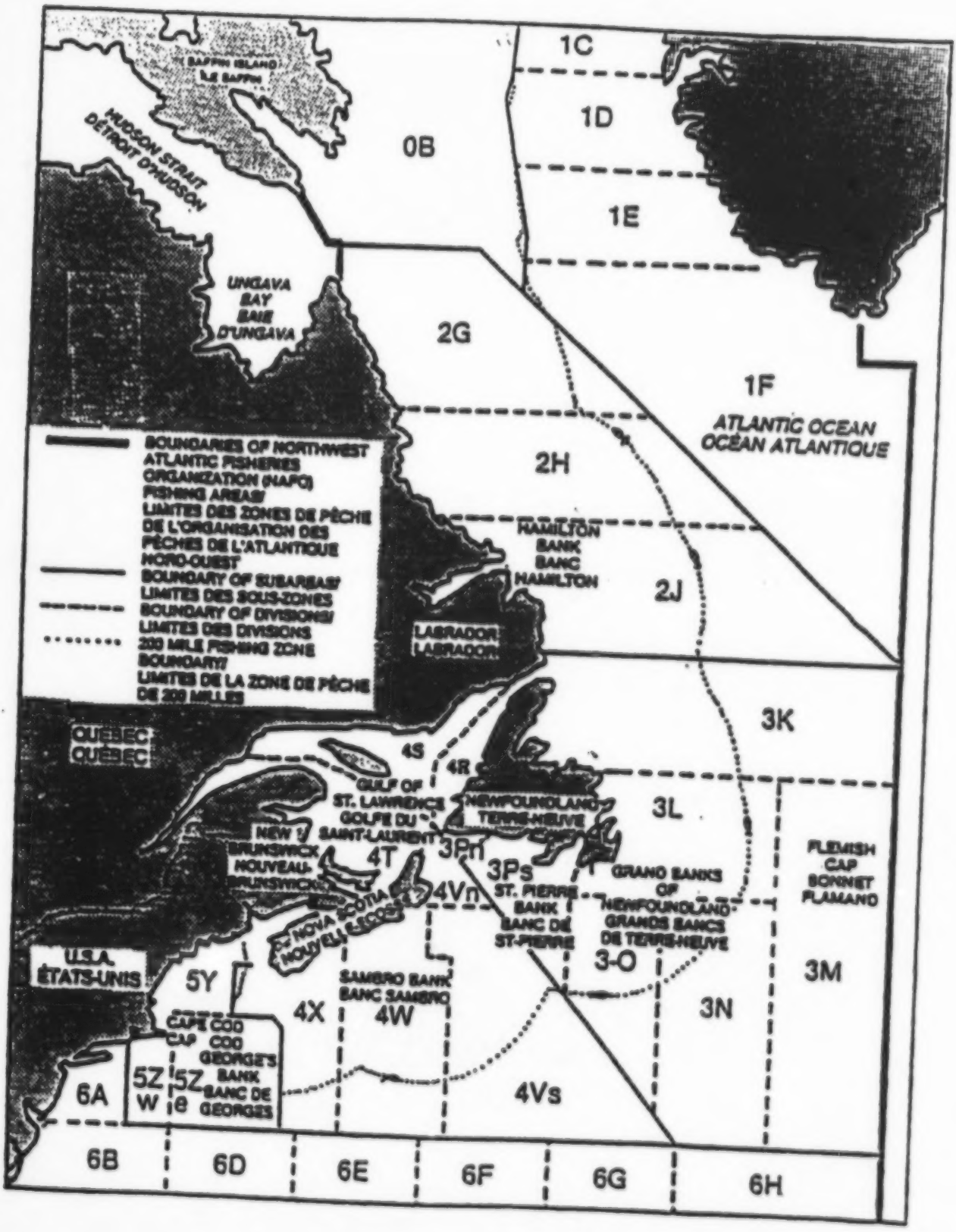
BAFFIN ISLAND
ÎLE BAFFIN
HUDSON STRAIT
DÉTROIT D'HUDSON
UNGAVA BAY
BAIE D'UNGAVA
0B
1C
1D
1E
1F
2G
2H
2J
ATLANTIC OCEAN
OCÉAN ATLANTIQUE
HAMILTON BANK
BANC HAMILTON
LABRADOR
LABRADOR
BOUNDARIES OF NORTHWEST ATLANTIC FISHERIES ORGANIZATION (NAFO) FISHING AREAS/
LIMITES DES ZONES DE PÊCHE DE L'ORGANISATION DES PÊCHES DE L'ATLANTIQUE NORD-OUEST
BOUNDARY OF SUBAREAS/
LIMITES DES SOUS-ZONES
BOUNDARY OF DIVISIONS/
LIMITES DES DIVISIONS
200 MILE FISHING ZONE BOUNDARY/
LIMITES DE LA ZONE DE PÊCHE DE 200 MILLES
QUEBEC
QUÉBEC
3K
4S
4R
GULF OF ST. LAWRENCE
GOLFE DU SAINT-LAURENT
NEWFOUNDLAND
TERRE-NEUVE
3L
NEW BRUNSWICK
NOUVEAU-BRUNSWICK
4T
3Pn
3Ps
ST. PIERRE BANK
BANC DE ST-PIERRE
GRAND BANKS OF NEWFOUNDLAND
GRANDS BANCS DE TERRE-NEUVE
FLEMISH CAP
BONNET FLAMAND
NOVA SCOTIA
NOUVELLE-ÉCOSSE
4Vn
U.S.A.
ÉTATS-UNIS
5Y
3-O
3M
SAMBRO BANK
BANC SAMBRO
4X
4W
3N
CAPE COD
CAP COD
GEORGES BANK
BANC DE GEORGES
5Zw
5Ze
6A
4Vs
6B
6D
6E
6F
6G
6H

Figure 1:

A P P E N D I X 3

DISTRIBUTION OF GULF OF ST LAWRENCE COD STOCKS IN 4RS, 3Pn AND 4TVn (.....)

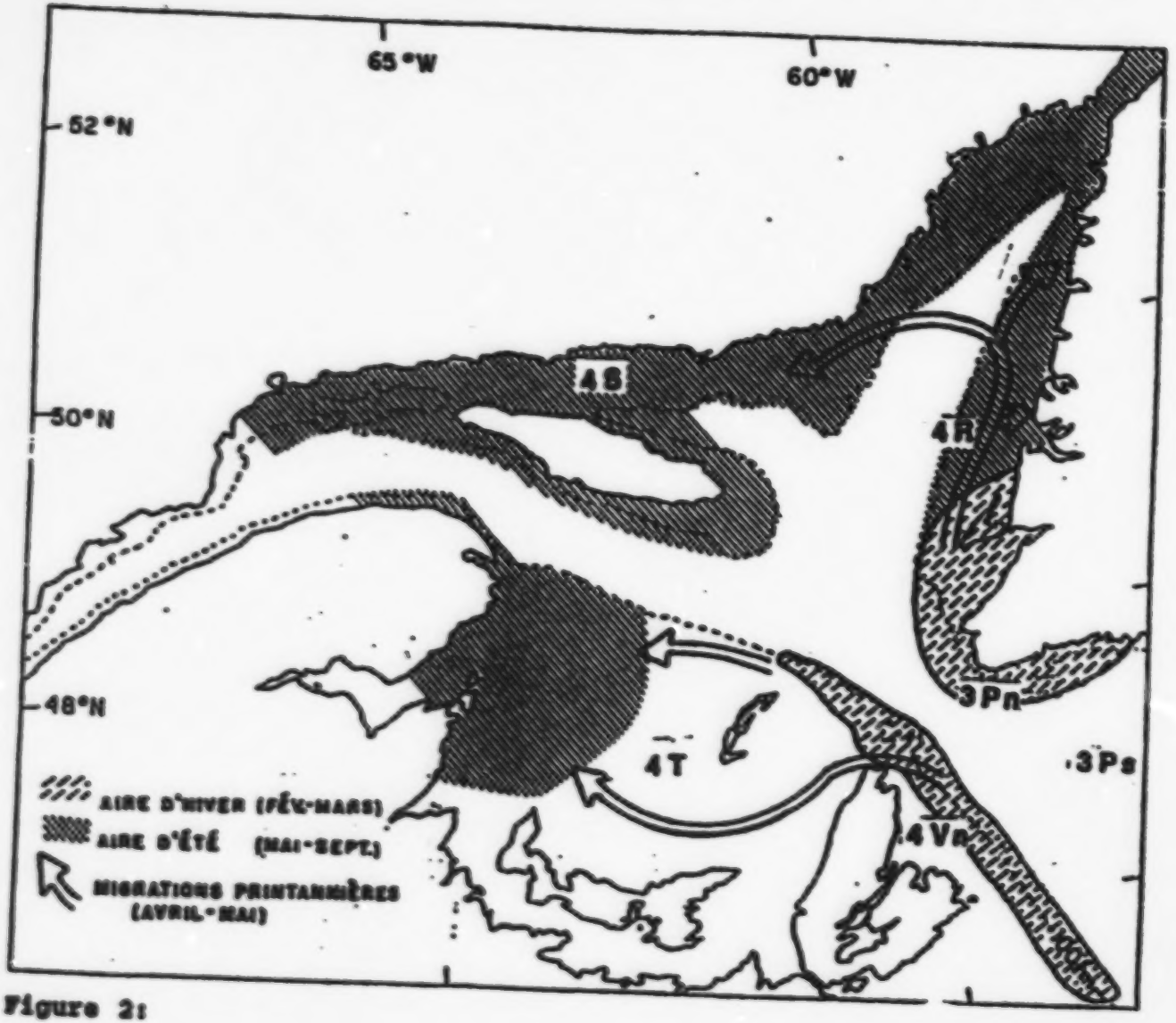
65°W
60°W
52°N
50°N
48°N
4S
4R
4T
3Pn
3Ps
4Vn
AIRE D'HIVER (FÉV.-MARS)
AIRE D'ÉTÉ (MAI-SEPT.)
MIGRATIONS PRINTANNIÈRES (AVRIL-MAI)

Figure 2:

A P P E N D I X 3

CHANGES IN LANDED CATCHES OF COD (LIVE WEIGHT) ON THE LOWER NORTH SHORE (1984-1988)

TABLE 3

(thousands of metric tons)

1984	7004
1985	5682
1986	3280
1987	2313
1988	2666

Source: DFO, Statistics and Information Systems Division, Quebec.

APPENDIX 4

SUBMERGED FLOATING CAGE

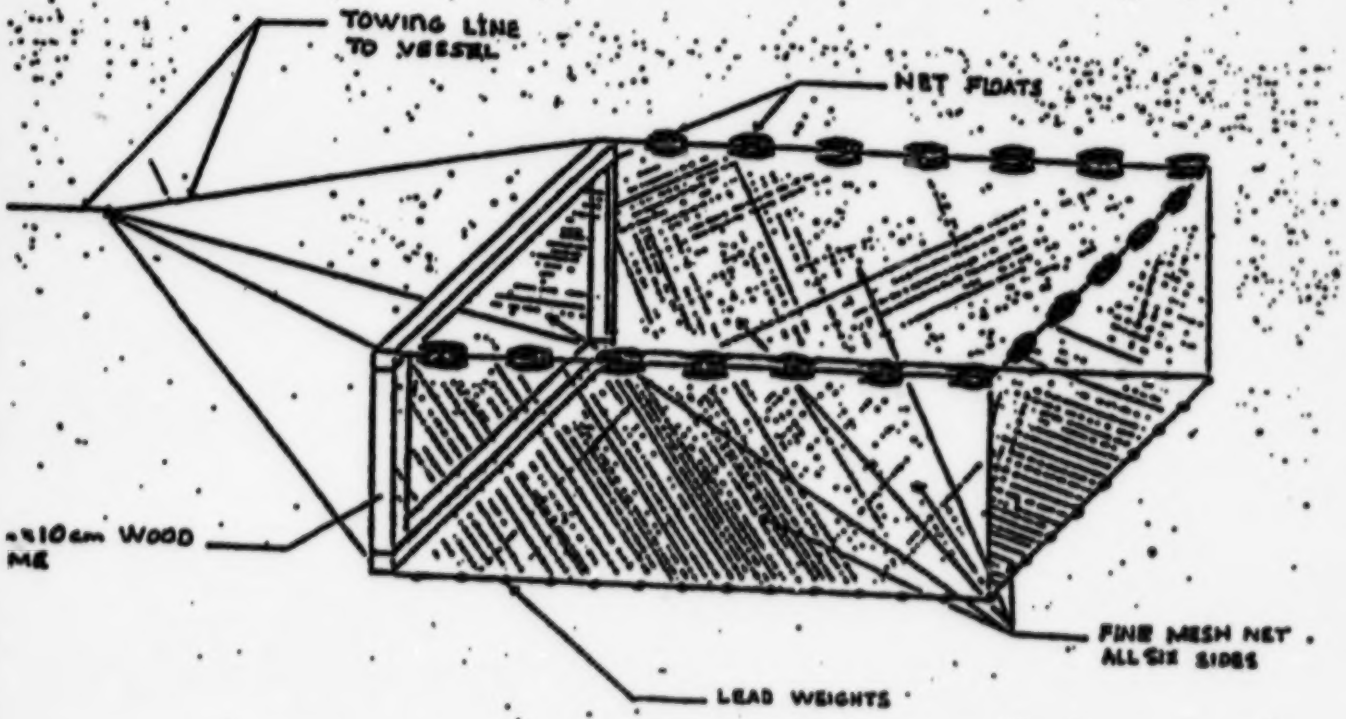

FIGURE 3:

Tiré de Hardy Darrell, Development of a cod aquaculture industry for Newfoundland, Avril 1986.

A P P E N D I X 5

COST AND REVENUE BREAKDOWN FOR OPERATING ACCOUNTS BY ACTIVITY

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

O P E R A T I N G A C C O U N T / A C T I V I T Y

ONGROWING COD

Year.....: 89

	Quantity /PU Total	Unit price	Amount /PU Total
998 Cod sales (kg)	100000	0,44	44000
PRODUCTS ($)			44000
332 Empl. wages ($)			10000
333 Fuel (Days)	125	14,00	1750
334 Cod purchases (kg)	55960	0,40	22384
511 Capelin purchases (kg)	154450	0,40	61780
Expenses ($)			95914
Margin ($)			-51914

APPENDIX 6

SIMULATION 1: WITHOUT GOVERNMENT ASSISTANCE

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5985

O P E R A T I N G A C C O U N T / A C T I V I T Y

GENERAL COD

Year.....:	89
	TOTAL AMOUNT
650 cage maintenance ($)	2250
652 Administration ($)	500
expenses ($)	2750
margin ($)	-2750

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

O P E N I N G B A L A N C E S H E E T (Breakdown) COD

ASSETS	88	89	LIABILITIES	88	89
Cash			Accounts payable		
ST investments			ST notes		
Accounts receivable			Production credit		
Receivables (subsidy)			Annuity instalments/loans		
			Accrued interest		
Cod to be sold					
Cod stocks					
Culture advances			MT loans (collateral)		18110
Supplies			LT loans (mortgage)		22500
Breeding stock			Equity		
Equipment		18110			
Cages		22500			
Land			Specify for the year 88		
Quotas			the amount of interest		
Shares			paid.		
Other LT investments					

O P E N I N G B A L A N C E S H E E T (Summary)

ASSETS	88	89	LIABILITIES	88	89
1-Liquid assets			3-ST debts		
2-receivables			ST		
7-livestock			5-MT and LT loans		
machinery		18110	MT		18110
building		22500	LT		22500
land					
other assets			9-equity		
quotas					
ASSETS		40610	LIABILITIES		40610

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

F I X E D A S S E T S

COD

FIXED ASSET PURCHASES	89
Fixtures & nets	1910
Towed cage	3000
Small tools	6000
Boat	7200
Cages	22500
Total	40610

FIXED ASSET SALES	89
Fixtures & nets	
Towed cage	
Small tools	
Boat	
Cages	
Total	

N E W B O R R O W I N G

NEW BORROWING	
Description	89
Short-term	
Medium-term	
Fixtures & nets	1910
Towed cage	3000
Small tools	6000
Boat	7200
Long-term	
Cages	22500
Total	40610

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

L O A N R E P A Y M E N T S COD

CAPITAL REPAYMENTS

Description	89
Medium-term	
Fixtures & nets	295
Towed cage	463
Small tools	926
Boat	1111
Long-term	
Cages	557
Total	3351

INTEREST REPAYMENTS

Description	89
Medium-term	
Fixtures & nets	248
Towed cage	390
Small tools	780
Boat	936
Long-term	
Cages	2925
Interest/Line of credit	4431
Total	9710

PISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

OPERATING INCOME	COD
NOMINAL ACCOUNT 89	
General -2750	
Ongrowing -51914	
Gross margin -54664	
- Interest 9710	
- Amortization 7108	
= Net income -71482	

CASH ACCOUNT	
CASH 89	
Opening balance	
+gross margin -54664	
+accounts receivable	
-supplier	
+stock sales	
-stock purchases	
+fixed asset sales	
-fixed asset purchases -40610	
+new borrowing 40610	
-capital repayment -3351	
-interest repayment -9710	
Balance -67725	

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

B U D G E T E D B A L A N C E S H E E T COD

ASSETS	START	89
1-Liquid assets		
2-Receivables		
4-Stocks		
7-Livestock		1910
Machinery	18110	19702
Buildings	22500	22800
Land		7200
Other assets		
Total assets	40610	51612
Quotas		22500
Total	40610	74112

LIABILITIES	START	89
Short-term debts		
3-Line of credit		67725
Suppliers		
Due/MTL	3351	3787
5-MT loans	15315	30267
LT loans	21943	43814
9-Equity		
Profit	----	-71482
Total	40610	74112

APPENDIX 7

SIMULATION 8: WITH GOVERNMENT ASSISTANCE

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

O P E N I N G B A L A N C E S H E E T (Breakdown) COD

ASSETS	88	89	LIABILITIES	88	89
Cash			Accounts payable		24366
ST investments			ST notes		
Accounts receivable			Production credit		
Receivables (subsidy)		24366	Annuity instalments/loans		
			Accrued interest		
Cod to be sold					
Cod stocks					
Culture advances			MT loans (collateral)		7243
Supplies			LT loans (mortgage)		9001
Costs paid in advance					
Breeding stock			Equity		24366
Equipment		18110			
Cages		22500			
Land			Specify for the year 88		
Quotas			the amount of interest		
Shares			paid.		
Other LT investments					

O P E N I N G B A L A N C E S H E E T (Summary)

ASSETS	88	89	LIABILITIES	88	89
1-Liquid assets			3-ST debts		
2-receivables		24366	ST		24366
7-livestock			5-MT and LT loans		
machinery		18110	MT		7243
building		22500	LT		9001
land					
other assets			9-equity		24366
quotas					
ASSETS		64976	LIABILITIES		64976

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5985

F I X E D A S S E T S

COD

FIXED ASSET PURCHASES	89
Fixtures & nets	1910
Towed cage	3000
Small tools	6000
Boat	7200
Cages	22500
Total	40610

FIXED ASSET SALES	89
Fixtures & nets	
Towed cage	
Small tools	
Boat	
Cages	
Total	

N E W B O R R O W I N G

NEW BORROWING	
Description	89
Short-term	
Medium-term	
Fixtures & nets	761
Towed cage	1202
Small tools	2397
Boat	2883
Long-term	
Cages	9001
Total	16244

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

L O A N R E P A Y M E N T S COD

CAPITAL REPAYMENTS

Description	89
Medium-term	
Fixtures & nets	117
Towed cage	185
Small tools	370
Boat	445
Long-term	
Cages	823
Total	1340

INTEREST REPAYMENTS

Description	89
Medium-term	
Fixtures & nets	99
Towed cage	156
Small tools	312
Boat	375
Long-term	
Cages	1170
Interest/Line of credit	4068
Total	6180

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

O P E R A T I N G I N C O M E

COD

NOMINAL ACCOUNT	88	89
General		-2750
Ongrowing		-51914
Gross margin		-54664
- Interest		6180
- Amortization		7108
= Net income		-67952

C A S H A C C O U N T

CASH	88	89
Opening balance		
+gross margin		-54664
+accounts receivable		24366
-supplier		
+stock sales		
-stock purchases		
+fixed asset sales		
-fixed asset purchases		-40610
+new borrowing		16244
-capital repayment		-1340
-interest repayment		-6180
Balance		-62184

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

B U D G E T E D B A L A N C E S H E E T COD

ASSETS	START	89
1-Liquid assets		
2-Receivables	24366	
4-Stocks		
7-Livestock		1910
Machinery	18110	19702
Buildings	22500	22800
Land		7200
Other assets		
Total assets	64976	51612
Quotas		
Total	64976	74112

LIABILITIES	START	89
Short-term debts		
3-Line of credit		62184
Suppliers	24366	24366
Due/MTL	1340	1515
5-MT loans	6125	12105
LT loans	8778	17528
9-Equity	24366	-43586
Profit	----	
Total	64976	74112

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5935

B R E A K - E V E N P O I N T A N A L Y S I S Business: Cod

I- FIXED COSTS	$
Cage maintenance	2250
Administration	500
Amortization	7108
Interest	6180
Total fixed costs	16038

II- VARIABLE COSTS	$
Cod purchases	23384
Capelin purchases	61780
Fuel	1750
Employee wages	10000
Total variable costs	95914

III- VARIABLE PRODUCTS	$
No of production units	100
Total quantity produced	100
Sales proceeds	44000
Production by PU	1
Unit price	440

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

B R E A K - E V E N P O I N T A N A L Y S I S Business: Cod

IV- BREAK-EVEN POINT	89
Fixed costs	16038
Variable costs	95914
Variable products	44000
Margin before fixed costs (MBFC)	-51914
No of PU at break-even point	
MBFC / PU	-519
Break-even point (PU)	-31
Projected No of PU	100
Margin of safety (%)	-484
Unit price at break-even point	
MBFC / unit of volume	-519
Break-even point (volume)	-31
Projected production volume	100
Margin of safety (%)	-484
Unit price at break-even point	
MBFC / $	-118
Break-even point (price)	-136
Projected unit price	440
Margin of safety (%)	-484

V- SENSITIVITY CRITERIA	
Minimum No of PU	254
Projected No of PU	100
Margin of safety in %	-61
Minimum production volume	254
Projected production volume	100
Margin of safety in %	-61
Minimum sales price	254
Projected sales price	100
Margin of safety in %	-61

FISHERIES AND OCEANS ECONOMIC SERVICES DIVISION 418-648-5925

B R E A K - E V E N P O I N T A N A L Y S I S Business: Cod

CONTINUED...

Profit will be nil if:	
Total costs increase by (%)	-61
Fixed costs increase by (%)	-424
Variable costs increase by (%)	-71
Products decrease by (%)	-154

Note: The break-even point or profitability threshold is calculated as follows: Fixed costs / MBPC per unit (PU, volume or price).

The sensitivity criteria measure the percentage change in one criterion (PU, volume or price), all other things being equal.

A P P E N D I X 8

SYNTHESIS OF THE TWO FINANCIAL SIMULATIONS, 1999

TABLE 4

ITEM	SIMULATION 1 . WITHOUT ASSISTANCE	SIMULATION 2 . WITH ASSISTANCE
OWNER'S EQUITY	-$71,482	-$43,586
CASH	-$67,725	-$62,184

DIVISION DES SERVICES ECONOMIQUES

ECONOMIC SERVICES DIVISION

Ministère des Pêches et des Océans - Région du Québec
Department of Fisheries and Oceans - Quebec Region

(1989-09-27)

Liste des rapports d'étude

1982

82-1 Répertoire des programmes d'aide gouvernementale à l'industrie des pêches au Québec; 101 pages (non disponible).

1983

83-1 Processus d'évaluation et de prise de décision pour l'attribution des permis de pêche pour les bateaux de 45 pieds et plus; Document de travail; 13 pages; (non disponible).

83-2 Répertoire des programmes d'aide gouvernementale à l'industrie des pêches au Québec; 183 pages (non disponible).

1984

84-1 Répertoire des programmes d'aide gouvernementale destinés à l'industrie des pêche maritimes du Québec; ISBN 0-662-92919-5; 67 pages (non disponible);

84-2 Simulation comptable du pêcheur côtier; 15 pages (non disponible).

84-3 Simulation comptable du pêcheur hauturier; 15 pages (non disponible).

84-4 Le registre comptable du pêcheur; 50 pages.

List of studies

1982

82-1 -

1983

83-1 -

83-2 -

1984

84-1 Guide to Government Assistance Programs for the Québec Marine Fishing Industry; ISBN 0-662-92919-5; 60 pages (not available).

84-2-3 Fisherman's Accounting Exercise; 15 pages; (not available).

84-4 Fisherman's Accounting Register; 50 pages; (not available).

1985

85-1 L'industrie des pêches maritimes du Québec: Description statistique; ISBN 0-662-93183-1; 184 pages.

85-2 Répertoire des programmes d'aide gouvernementale destinés à l'industrie des pêches maritimes du Québec; ISBN 0-662-93438-5; 77 pages.

85-3 Etude de rentabilité de la flotte de pêche au crabe du Québec: 1984; 47 pages. (non disponible)

85-4 Etude de rentabilité du secteur de la transformation du crabe des neiges au Québec: 1984; 38 pages.

85-5 Coûts et revenus des bateaux de pêche sélectionnés du Québec: 1984; 113 pages.

85-6 Etude de rentabilité: crabiers côtiers-Estuaire du Saint-Laurent et Moyenne Côte-nord: 1984; 88 pages. (non disponible)

85-7 Description de la flotte de pêche du Québec: 1984; 51 pages;

85-8 Impact de l'addition de nouveaux parcs semi-hauturiers dans la pêche au crabe du sud-ouest du Golfe; Document de travail; 25 pages. (non disponible).

1985

85-1 The Maritime Fisheries Industry of Québec: Statistical Description; ISBN 0-662-93183-1; 184 pages (not available).

85-2 Guide to Government Assistance Programs for the Québec Marine Fisheries Industry; ISBN 0-662-93438-5; 78 pages; (not available).

85-3 Study on the viability of the Quebec Crab Fleet: 1984; 47 pages. (not available).

85-4 Economic Performance for the Crab Processing in Québec: 1984; 35 pages. (not available).

85-5 Costs and Earnings for Selected Fishing Boats in Québec: 1984; 113 pages.

85-6 -

85-7 -

85-8 -

1986

Etude de rentabilité des composantes de l'industrie des pêches maritimes québécoises liées aux chalutiers de moins de 100 pieds: 1985

86-1 volume 1 Les crevettiers; ISBN-0-662-93853-4; 71 pages;

86-2 volume 2 Les chalutiers exploitant les poissons de fond; ISBN-0-662-93857-7; 83 pages.

86-3 volume 4 Les usines de transformation des poissons de fond; ISBN-0-687-94387-3; 81 pages.

1986

Profitability Study on various Components of Québec Maritime Fishing Industry which are Associated with Trawlers under 100 feet in length: 1985

86-1 volume 1 Shrimp Trawlers; ISBN-0-662-24157-2; 71 pages.

86-2 volume 2 Groundfish Trawlers; ISBN-0-662-93857-7; 83 pages.

86-3 volume 4 Groundfish Plants; ISBN-0-687-94387-3; 81 pages.

	Les usines de transformation de produits marins au Québec	Québec Marine Processing Plants
86-4	volume 1 Répertoire des producteurs; ISBN-0-662-93914-x; 95 pages.	volume 1 Directory of Producers; ISBN-0-662-93914-x; 95 pages.
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